

TPM 21079
ER 07-02-012

CREW ENGINEERING
AND SURVEYING
5725 KEARNY VILLA ROAD, SUITE D
SAN DIEGO, CALIFORNIA 92123
(858) 571-0555

Preliminary Drainage Study

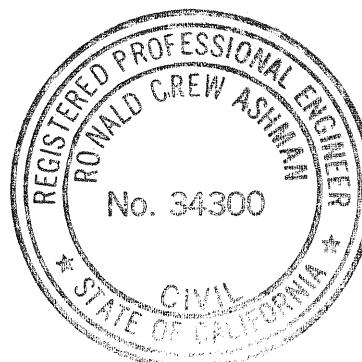
Hydrology and Hydraulic Calculations for Hamilton Lane T.P.M.

Introduction

The project is located on Hamilton Lane in Fallbrook. The owner LMP Investments LLC., proposes to subdivide the 3.57 acre Parcel B of B/C 06-0068 into 3 parcels. The site is currently vacant. The site is an active avocado grove and has mild slopes.

This study is to estimate the developed runoff from and across the site and the surface drainage features that have been proposed to safely convey runoff to the existing natural drainage courses. This property is near the top of the watershed. There is limited area draining onto the property from off site. A ridge feature splits the property approximately in half. Runoff developed to the North of this ridge will drain to an existing 12" CMP running under Mission Road. Runoff developed south of the ridge will drain from the site via sheet flow across the Southern and Eastern property boundaries.

No diversions will result from the proposed project and runoff quantities exiting the site will remain substantially the same following the development of this property.



ENGINEER OF WORK:
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EXPIRES SEPTEMBER 30, 2009

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Methodology

The limits of the drainage basins were determined using county topographic maps at 1"=200' scale. A site inspection and survey was conducted to verify the drainage basin and flow patterns.

The Rational Method ($Q=CIA$) was used to calculate the runoff.

Manning's Equation was used for ditch and pipe capacity checks.

Intensity based on 100 year frequency storm.

Equation for determining the time of concentration (T_c) for natural watersheds:

$$T_c = T_i + \sum T_t$$

Initial Time of Concentration (T_i) determined from Table 3-2

Travel time (Tt) is calculated for each reach of watershed by Manning's Equation

Rational Method intensity calculation:

100 Year Frequency: P6 = 3.0" P24 = 5.5" P6 / P24 = 55%; so no adjustment required

$$D = T_c, I = 7.44 \times P6 \times D^{-0.645}$$

Pre-Development Drainage Basin Parameters

Basin	Length(mi)	Height (ft)	Tc (min)	C	I (in/min)	Area (ac)	Q100(cu.ft/s)	Ti(min)	V100 (fps)
A	0.14	70.00	9.48	0.36	5.58	2.74	5.50	6.4	9.51
B	0.15	70.00	9.66	0.36	5.51	2.70	5.36	6.4	N/A

Post-Development Drainage Basin Parameters

Basin	Length(mi)	Height (ft)	Tc (min)	C	I (in/min)	Area (ac)	Q100(cu.ft/s)	Ti(min)	V100 (fps)
A	0.14	70.00	9.48	0.40	5.58	2.74	6.12	6.4	9.65
B	0.15	70.00	9.66	0.46	5.51	2.70	6.84	6.4	N/A

Weighted Runoff Coefficient Calculation for Basin A:

$$C = 0.90x(\% \text{ Impervious}) + C_p x(1 - \% \text{ Impervious})$$

Post-Development

$$\begin{aligned} C &= 0.90 \times (7.3\%) + 0.36 \times (1-7.3\%) \\ C &= 0.40 \end{aligned}$$

Weighted Runoff Coefficient Calculation for Basin B:

$$C = 0.90x(\% \text{ Impervious}) + C_p x(1 - \% \text{ Impervious})$$

Post-Development

$$\begin{aligned} C &= 0.90 \times (18.5\%) + 0.36 \times (1-18.5\%) \\ C &= 0.46 \end{aligned}$$

Conclusion

The estimated developed runoff from Basin A prior to construction is 5.5 cfs, and post-construction runoff is 6.1 cfs. Based on the hydraulic calculations for the existing storm drain at the discharge point, the increase in velocity and depth of flow are negligible, and should not cause the facility to become overburdened or result in any substantial erosion or siltation. The estimated developed runoff from Basin B prior to construction is 5.4 cfs, and post-construction runoff is 6.8 cfs. As mitigation for this increase, rip rap sump energy dissipation devices are proposed where runoff exits the pads and driveways, in order to return the runoff to sheet flow. Since the runoff from Basin B leaves the site via sheet flow over a broad area, and no concentration of flows is proposed, the minor increase in runoff should not cause any existing drainage facilities to become overburdened, or result in any substantial erosion or siltation onsite or offsite. The drainage pattern of the site will not significantly change due to the construction of this project.

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: HAMILTON LANE TPM

Comment: EXISTING 12" CMP AT PT. A (PRE-DEVELOPMENT)

Solve For Actual Depth

Given Input Data:

Diameter.....	1.00 ft
Slope.....	0.1200 ft/ft
Manning's n.....	0.024
Discharge.....	5.51 cfs

Computed Results:

Depth.....	0.69 ft
Velocity.....	9.51 fps
Flow Area.....	0.58 sf
Critical Depth....	0.94 ft
Critical Slope....	0.0705 ft/ft
Percent Full.....	69.17 %
Full Capacity.....	6.69 cfs
QMAX @ .94D.....	7.19 cfs
Froude Number.....	2.11 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: HAMILTON LANE TPM

Comment: EXISTING 12" CMP AT PT. A (POST- DEVELOPMENT)

Solve For Actual Depth

Given Input Data:

Diameter.....	1.00 ft
Slope.....	0.1200 ft/ft
Manning's n.....	0.024
Discharge.....	6.12 cfs

Computed Results:

Depth.....	0.75 ft
Velocity.....	9.65 fps
Flow Area.....	0.63 sf
Critical Depth....	0.96 ft
Critical Slope....	0.0875 ft/ft
Percent Full.....	75.25 %
Full Capacity.....	6.69 cfs
QMAX @ .94D.....	7.19 cfs
Froude Number.....	1.98 (flow is Supercritical)

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

NRCS Elements	Land Use	County Elements	Runoff Coefficient "C"				
			% IMPER.	A	B	Soil Type	
NRCS Elements	Land Use	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain Low	Permanent Open Space		0*	0.20	0.25	0.30	0.35
	Residential, 1.0 DU/A or less		10	0.27	0.32	0.36	0.41
Low	Residential, 2.0 DU/A or less		20	0.34	0.38	0.42	0.46
	Residential, 2.9 DU/A or less		25	0.38	0.41	0.45	0.49
Medium Density Residential	Residential, 4.3 DU/A or less		30	0.41	0.45	0.48	0.52
	Residential, 7.3 DU/A or less		40	0.48	0.51	0.54	0.57
Medium Density Residential	Residential, 10.9 DU/A or less		45	0.52	0.54	0.57	0.60
	Residential, 14.5 DU/A or less		50	0.55	0.58	0.60	0.63
Medium Density Residential	Residential, 24.0 DU/A or less		65	0.66	0.67	0.69	0.71
	Residential, 43.0 DU/A or less		80	0.76	0.77	0.78	0.79
High Density Residential Commercial/Industrial	Neighborhood Commercial		80	0.76	0.77	0.78	0.79
	General Commercial		85	0.80	0.80	0.81	0.82
Commercial/Industrial	Office Professional/Commercial		90	0.83	0.84	0.84	0.85
	Limited Industrial		90	0.83	0.84	0.84	0.85
Commercial/Industrial	General Industrial		95	0.95	0.97	0.95	0.97

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the previous runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

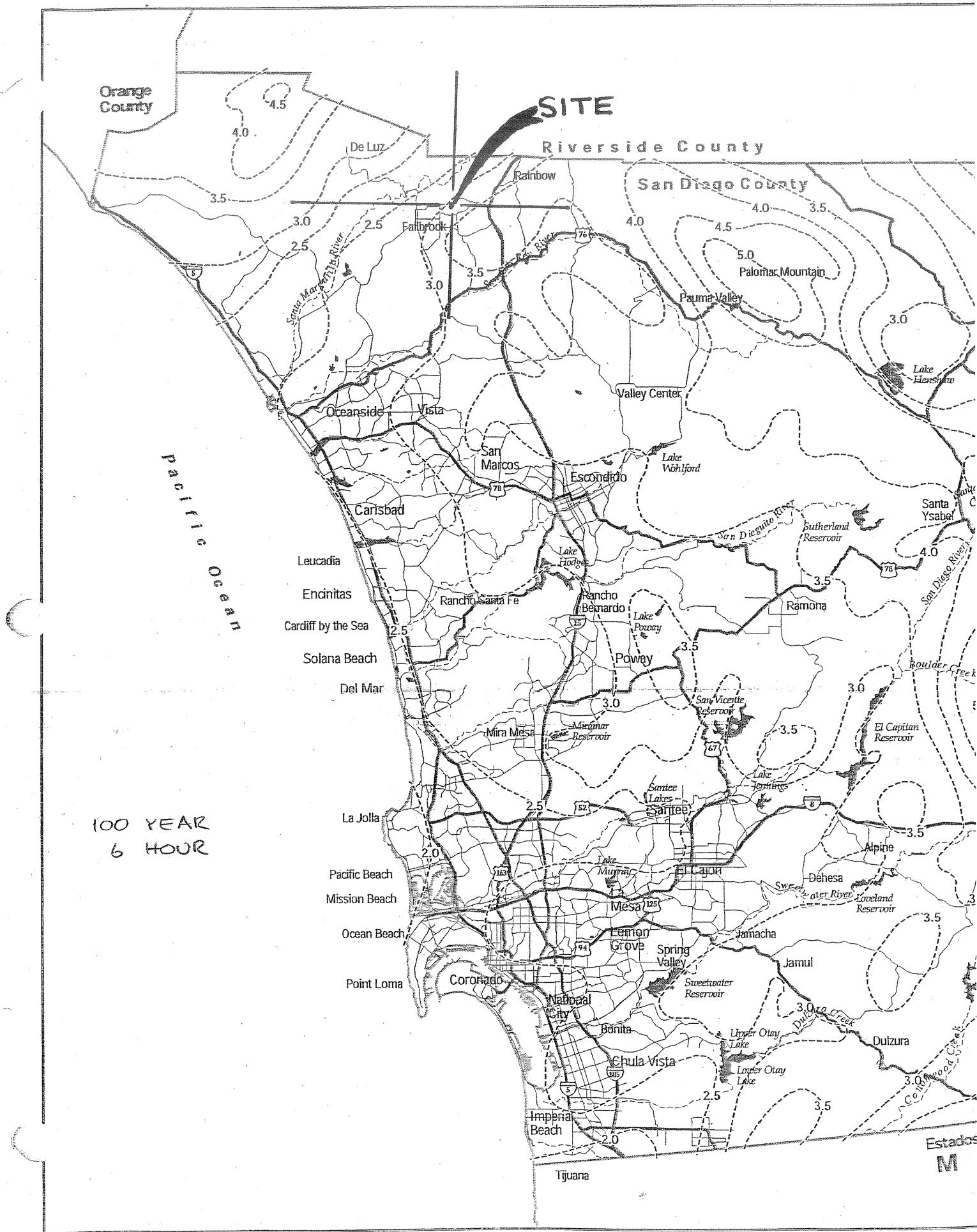
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

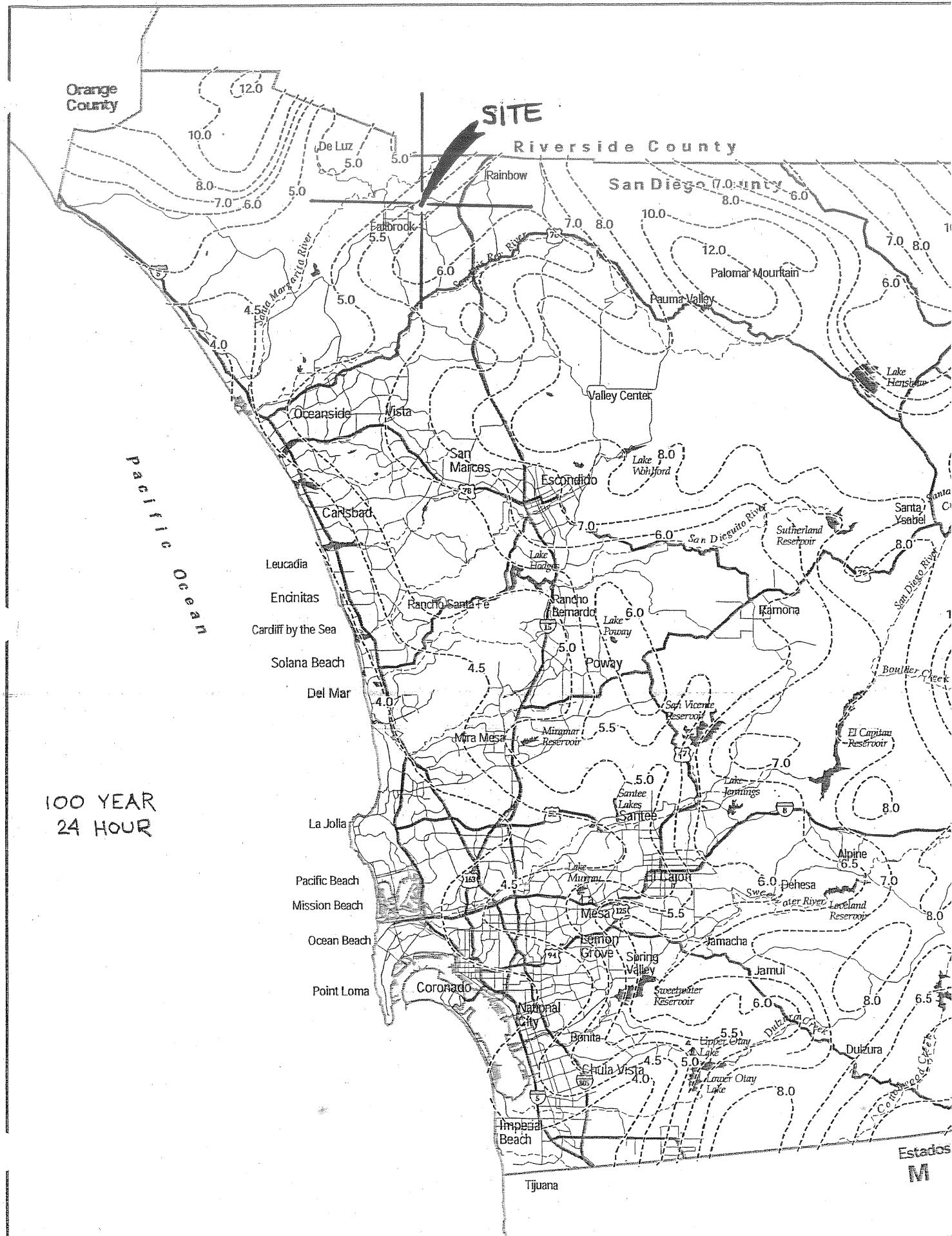
Table 3-2

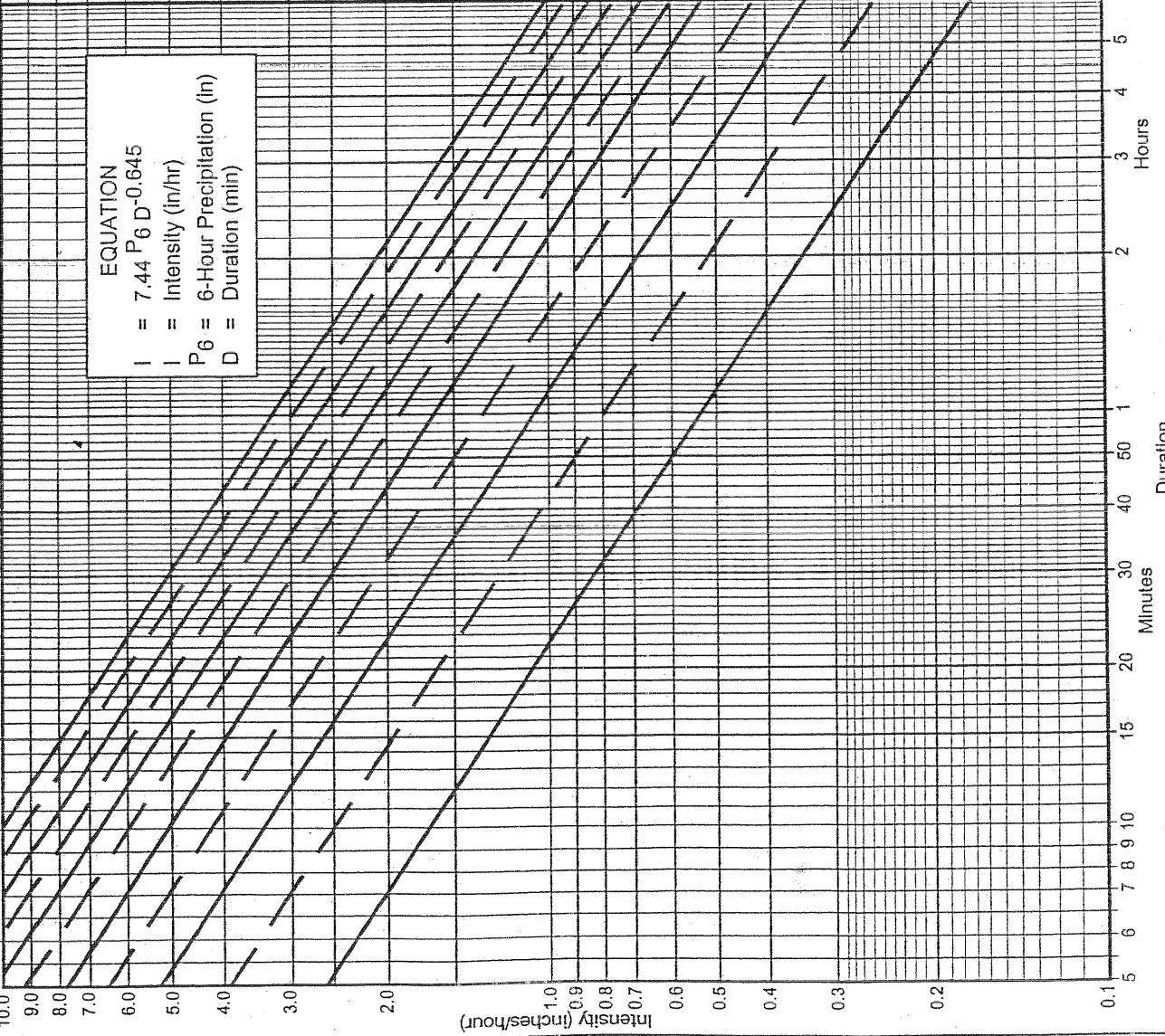
**MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i										
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description







Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the Intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{3.0}$ in. $P_{24} = \underline{5.5}$ in. $\frac{P_6}{P_{24}} = \underline{55}$ % (2)
- (c) Adjusted $P_6^{(2)} = \underline{3.0}$ in.
- (d) $t_x = \underline{\quad}$ min. SEE CHART
- (e) $I = \underline{\quad}$ in./hr. PAGE 3

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

PG Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.19	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.46	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.69	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
210	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

F I L E U R E

3-1

(Join 5 sheets).

T. 98. I. T.

A

Low Runoff Potential

B

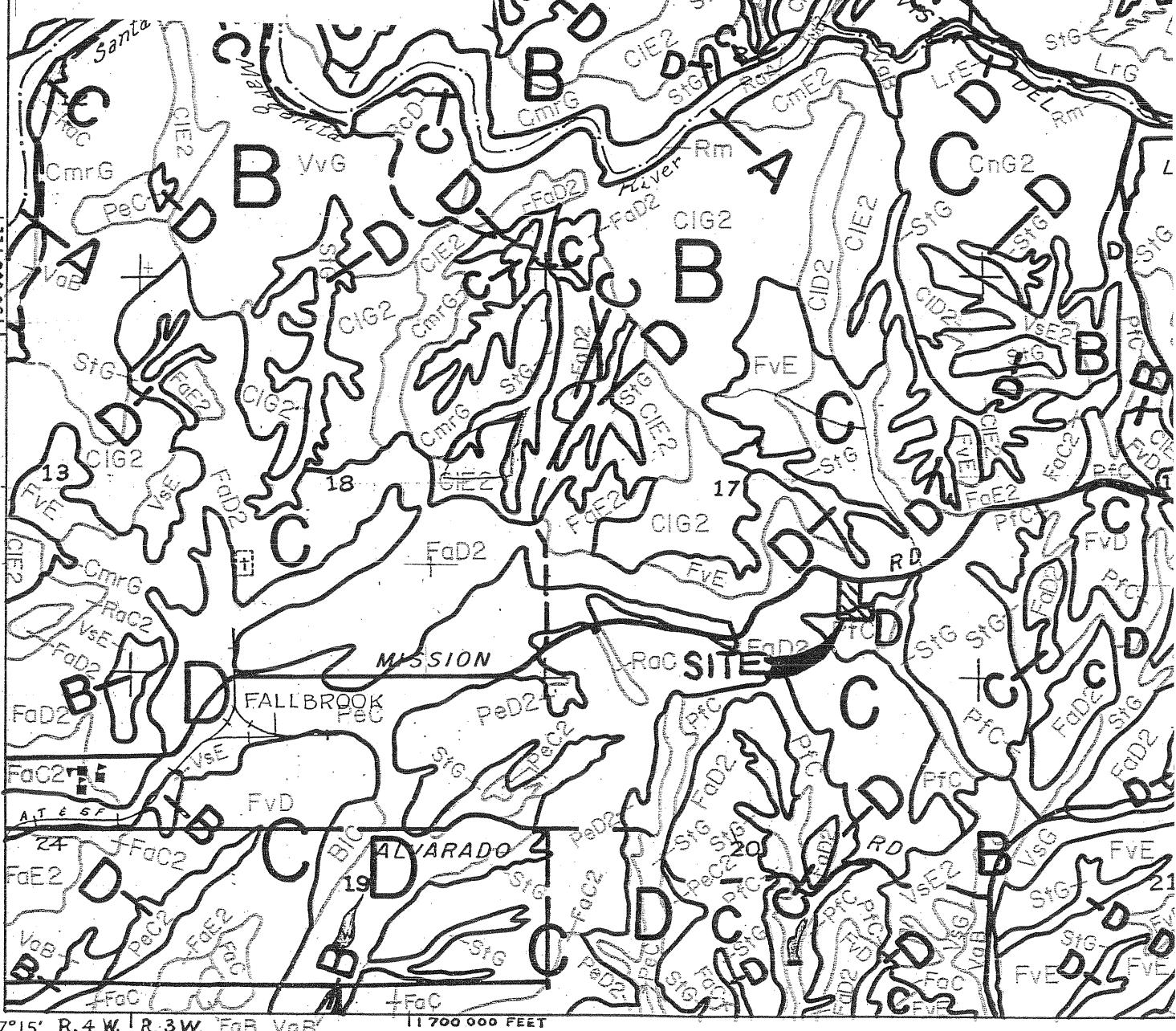
Moderate Runoff Potential

C

High Runoff Potential

1

Very High Runoff Potential



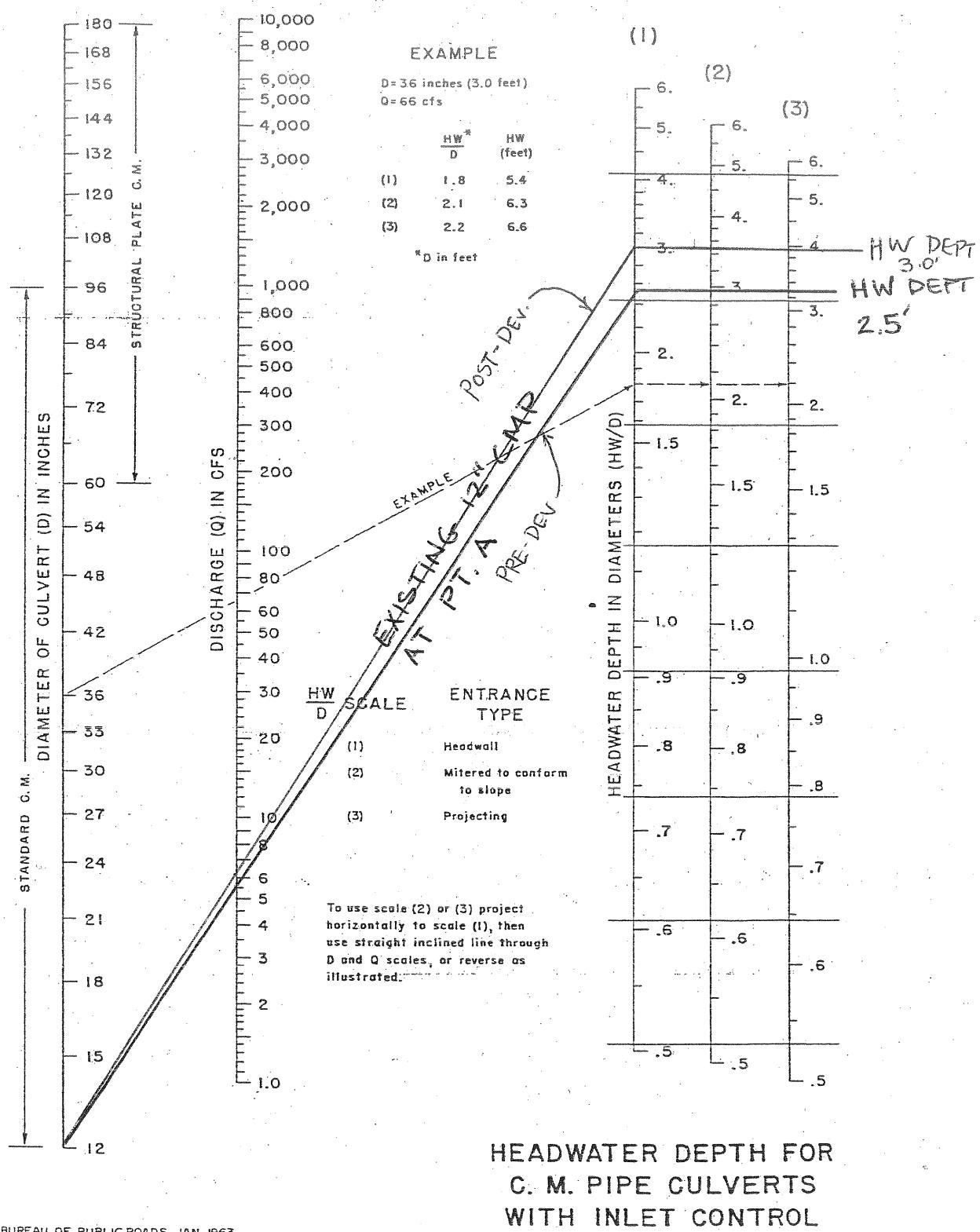
Average Values of Roughness Coefficient (Manning's n)

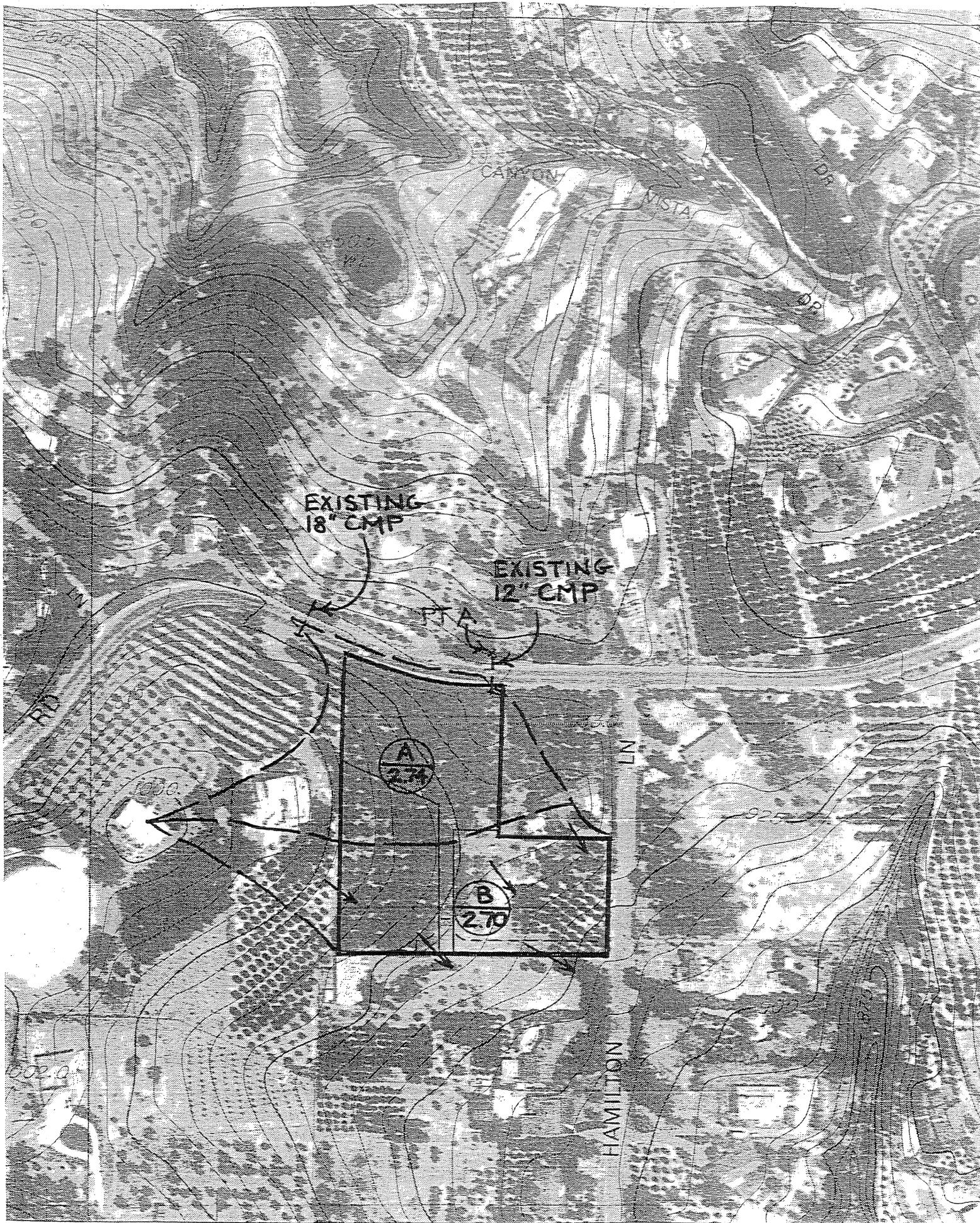
Type of Waterway	Roughness Coefficient (n)
1. Closed Conduits (1)	
SPIRAL RIB	0.011
Steel (not lined)	0.015
Cast Iron	0.015
Aluminum	.021
Corrugated Metal (not lined)	0.024
Corrugated Metal (2) (smooth asphalt quarterlining)	0.021
Corrugated Metal (2) (smooth asphalt half lining)	0.018
Corrugated Metal (smooth asphalt full lining)	0.012 ↙
Concrete RCP	0.012 ↙
Clay (sewer)	0.013
Asbestos Cement	0.011
Drain Tile (terra cotta)	0.015
Cast-in-place Pipe	0.015
Reinforced Concrete Box	0.014
PVC	0.009
2. Open Channels (1)	
a. Unlined	
Clay Loam	0.023
Sand	0.020 ↗
b. Revetted	
Gravel	0.030
Rock	0.040
Pipe and Wire	0.025
Sacked Concrete	0.025
c. Lined	
Concrete (poured)	0.014
Air Blown Mortar (3)	0.016
Asphaltic Concrete or Bituminous Plant Mix	0.018
d. Vegetated (5)	
Grass lined, maintained	.035 ↗
Grass and Weeds	.045 ↗
Grass lined with concrete low flow channel	.032
3. Pavement and Gutters (1)	
Concrete	0.015
Bituminous (plant-mixed)	0.016

P = A
WR

25
15

Type of Waterway	Roughness Coefficient (n)
4. Depressed Medians (10:1 slopes)(1)	
Earth (without growth)	0.040
Earth (with growth)	0.050
Gravel	0.055
5. Natural Streams(4)	
a. Minor streams (surface width at flood stage < 100 ft)	
(1) Fairly regular section	
(a) Some grass and weeds, little or no brush	0.030 ←
(b) Dense growth of weeds, depth of flow materially greater than weed height	0.040
(c) Some weeds, light brush on banks	0.040
(d) Some weeds, heavy brush on banks	0.060
(e) For trees within channel with branches submerged at high stage, increase all above values by 0.015	
(2) Irregular section, with pools, slight channel meander	
Channels (a) to (e) above, increase all values by 0.015	
(3) Mountain streams; no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage	
(a) Bottom, gravel, cobbles and few boulders	0.050
(b) Bottom, cobbles with large boulders	0.060
b. Flood plains (adjacent to natural streams)	
(1) Pasture, no brush	
(a) Short grass	0.030
(b) High grass	0.040
(2) Cultivated areas	
(a) No crop	0.040
(b) Mature row crops	0.040
(c) Mature field crops	0.050
(3) Heavy weeds, scattered brush	0.050
(4) Light brush and trees	0.060
(5) Medium to dense brush	0.090
(6) Dense willows	0.170
(7) Cleared land with tree stumps, 100-150 per acre	0.060
(8) Heavy stand of timber, little undergrowth	
(a) Flood depth below branches	0.110
(b) Flood depth reaches branches	0.140





1705E

DRAINAGE BASIN MAP
SCALE: 1" = 200'

INDEX TO AN INMING SHEET

1338
5/8/01

CAMI REC